OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **PERKINS POND,** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *worsening* in-lake chlorophyll-a trend since 1996. All chlorophyll concentrations were above the NH mean reference line this season. In August, it was noted that there were complaints of a fishy odor to the pond, which is often caused by blooms of golden brown algae. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are external and internal sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *fairly stable,* yet *slightly worsening* trend overall in lake transparency. Lake transparency decreased this season. Elevated algal concentrations and stirring up of bottom sediments by boating traffic are likely to cause a decrease in water clarity for Perkins Pond. The 2000 sampling season also was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth

over time. These graphs show a *fairly stable* trend in the upper water layer, and a *slightly worsening* trend in the lower water layer. Hypolimnetic phosphorus concentrations in June were most likely as a result of the sample being turbid. Bottom sediment contains phosphorus bound to the particles and can cause elevated and inaccurate phosphorus results. Phosphorus concentrations in both layers were relatively the same this season. The shallow depth of Perkins Pond allows the water to mix throughout the season. Wind and wave action and boating traffic mix the surface waters with deeper water so the pond does not stratify. Boating traffic also stirs up bottom sediment, which can elevate phosphorus concentrations and cause an increase in algal growth. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- *E. coli* originates in the intestines of warm-blooded animals (including humans) and is an indicator of associated and potentially harmful pathogens. Bacteria concentrations were all very low at the sites tested (Table 12). If residents are concerned about septic system impacts, testing when the water table is high or after rains is best. Please consult the Other Monitoring Parameters section of the report for the current standards for *E. coli* in surface waters.

- Total phosphorus concentrations (Table 8) were elevated in June for both the hypolimnion and Inlet sample. Both samples were excessively turbid (Table 11) at the time, and probably contained large amounts of organic debris. When sampling, please try to obtain a clean sample. If bottom sediment is stirred up after sounding the bottom with the Kemmerer bottle for the depth, either wait for the sediment to settle or try sampling off of a different side of the boat. If the Inlet is stagnant or not flowing, or if the flow is too low to obtain a clean sample, do not take the sample and mark in the Personal Observations section of the field data sheet that no sample could be taken.

- Dissolved oxygen was again high at all depths of the lake (Table 9). As stratified lakes age, oxygen is depleted in the lower layer by the process of decomposition. The lack of this aging indicator is a sign of the lake's overall health. Dissolved oxygen saturation was greater than 100% at two meters and above in August this season. Layers of algae can raise the dissolved oxygen in the water as a product of photosynthesis. Considering there were probable algae blooms in June and July, and that the chlorophyll-a concentrations were still

elevated in August, we suspect that the abundance of algae caused the super saturation.

- There is some confusion about what end of Perkins Pond the Outlet is located on. In August this season during the biologist's visit, we determined that water flowing from Ledge Pond Brook was actually flowing out of the pond and not into the pond. At that time, we took an Outlet sample at the site normally labeled Ledge Pond Brook since there was no flow at the other outlet site. We were informed that a beaver dam had been removed from the brook, which normally directs the water flow into the pond. With the removal of the beaver dam, it seems that the water now flows out of the pond. We recommend the volunteers contact the VLAP coordinator at 271-2658 in the spring so that we can walk this Inlet/Outlet to track the direction of water flow and determine if there are actually two outlets for the pond, and solve this mystery.

NOTES

- Biologist's Note (6/19/00): No site of sampling on bottle.
- Monitor's Note (6/19/00): Outlet not flowing, no sample.
- Monitor's Note (7/10/00): Raining heavily recently.
- Monitor's Note (8/10/00): Assoc. is considering sewer system for lake residents. Some residents considering possibility of a dam. Complaints of fishy odor. More weed growth noticed this year. Beaver dam removed that once was in the Inlet. Beaver dam removal caused water to flow out of the pond, therefore creating another outlet.
- Biologist's Note (8/10/00): Outlet sample was taken where the dam had been removed. Normal outlet was too shallow to take sample.

USEFUL RESOURCES

Beavers and Their Control. UNH Cooperative Extension/NH Fish and Game, 1990. (603) 862-2346, or ceinfo.unh.edu

Bacteria in Surface Waters, WD-BB-14, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Answers to Common Lake Questions, NHDES-WSPCD-92-12, NHDES Booklet, (603) 271-3503.

Effects of Phosphorus on New Hampshire's Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

What is a Watershed?, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, *NHDES-WD 97-8*, NHDES Booklet, (603) 271-3503

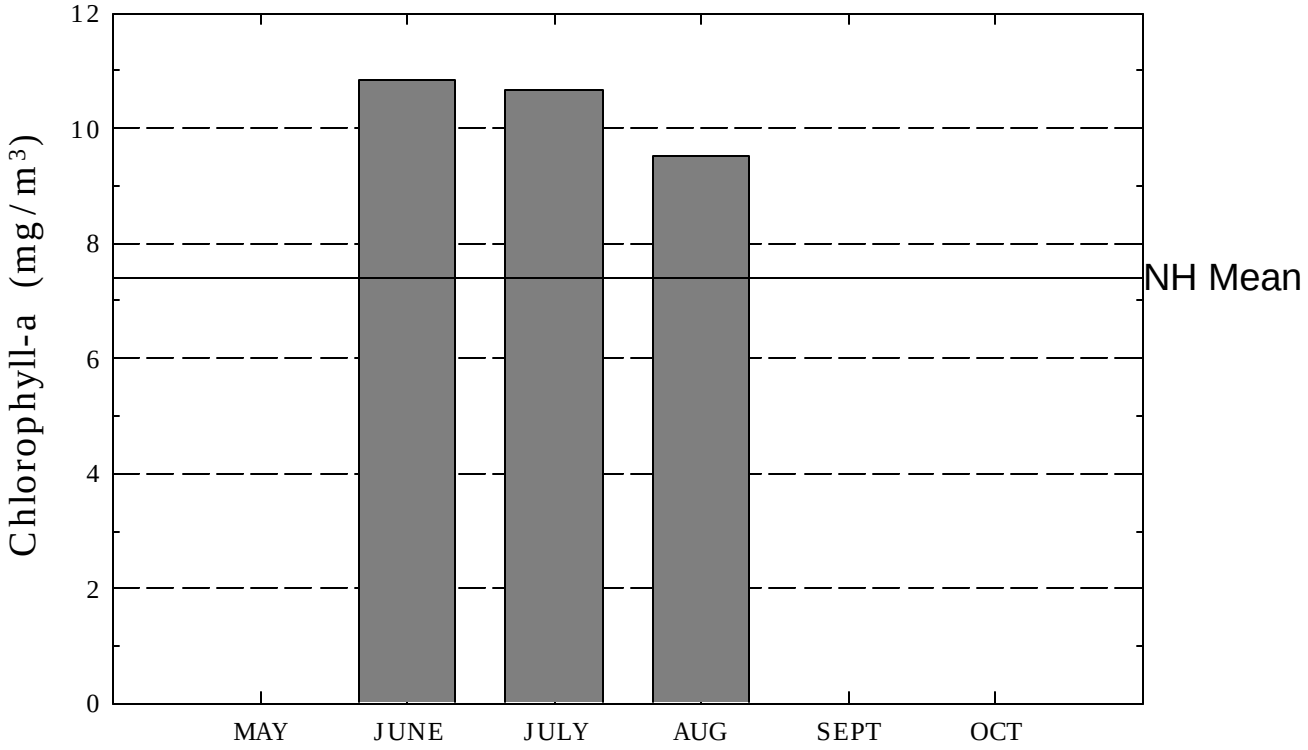
Septic Systems and Your Lake's Water Quality, *WD-BB-11*, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

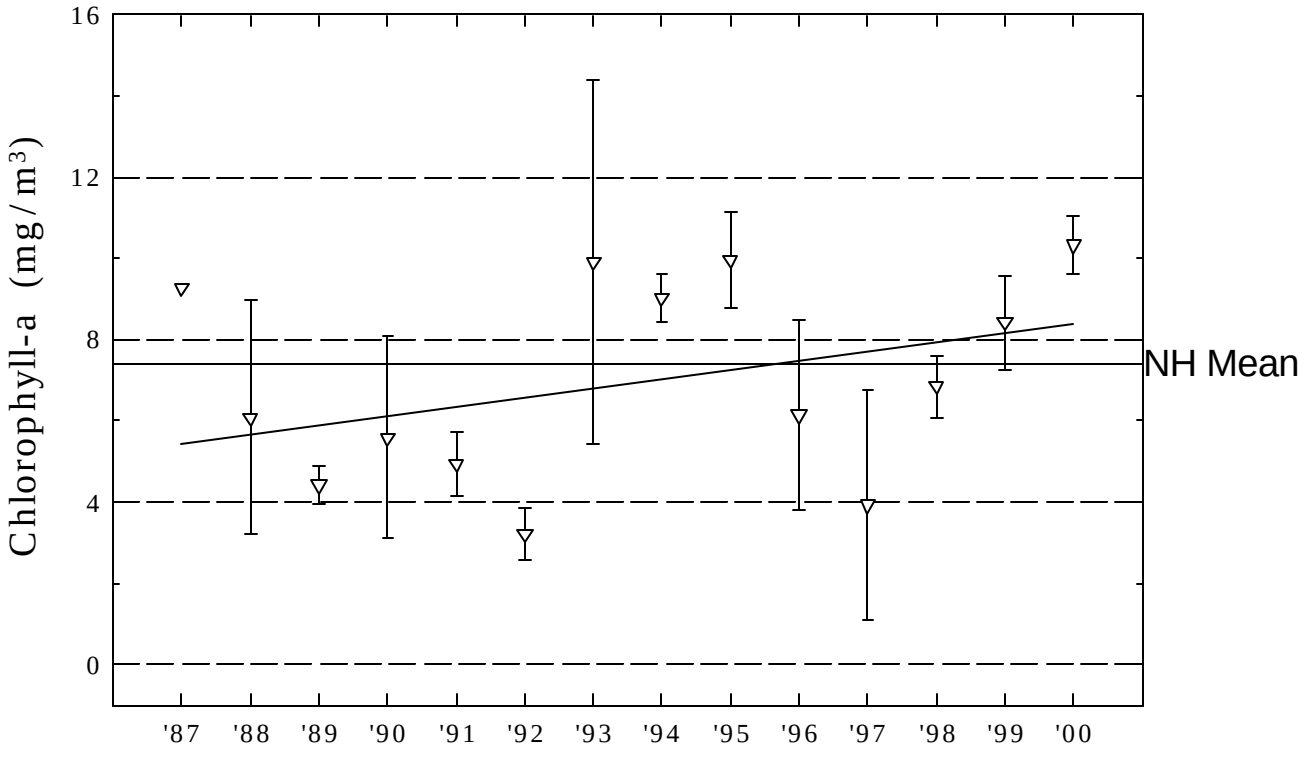
Low Impact Boating, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Perkins Pond

Figure 1. Monthly and Historical Chlorophyll-a Results



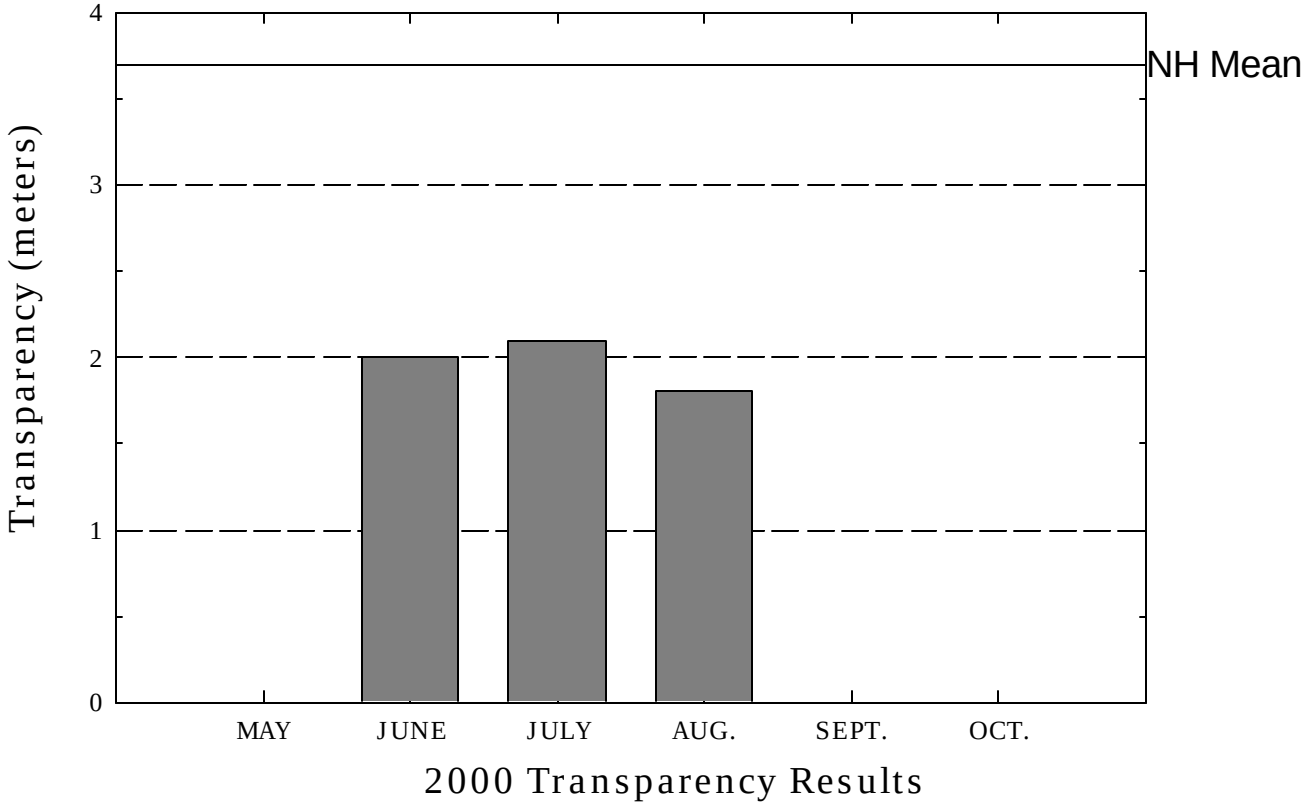
2000 Chlorophyll-a Results

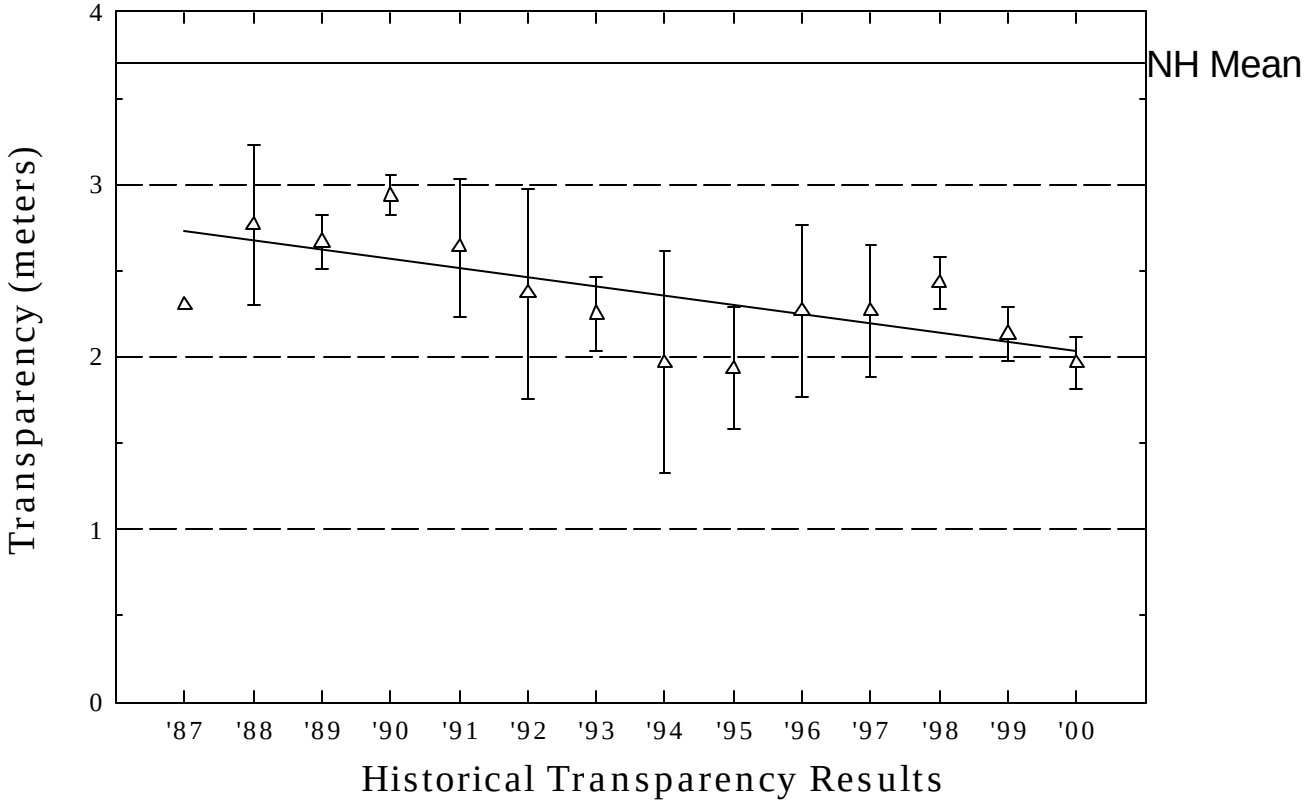


Historical Chlorophyll-a Results

Perkins Pond

Figure 2. Monthly and Historical Transparency Results





Perkins Pond

Figure 3. Monthly and Historical Total Phosphorus Data.

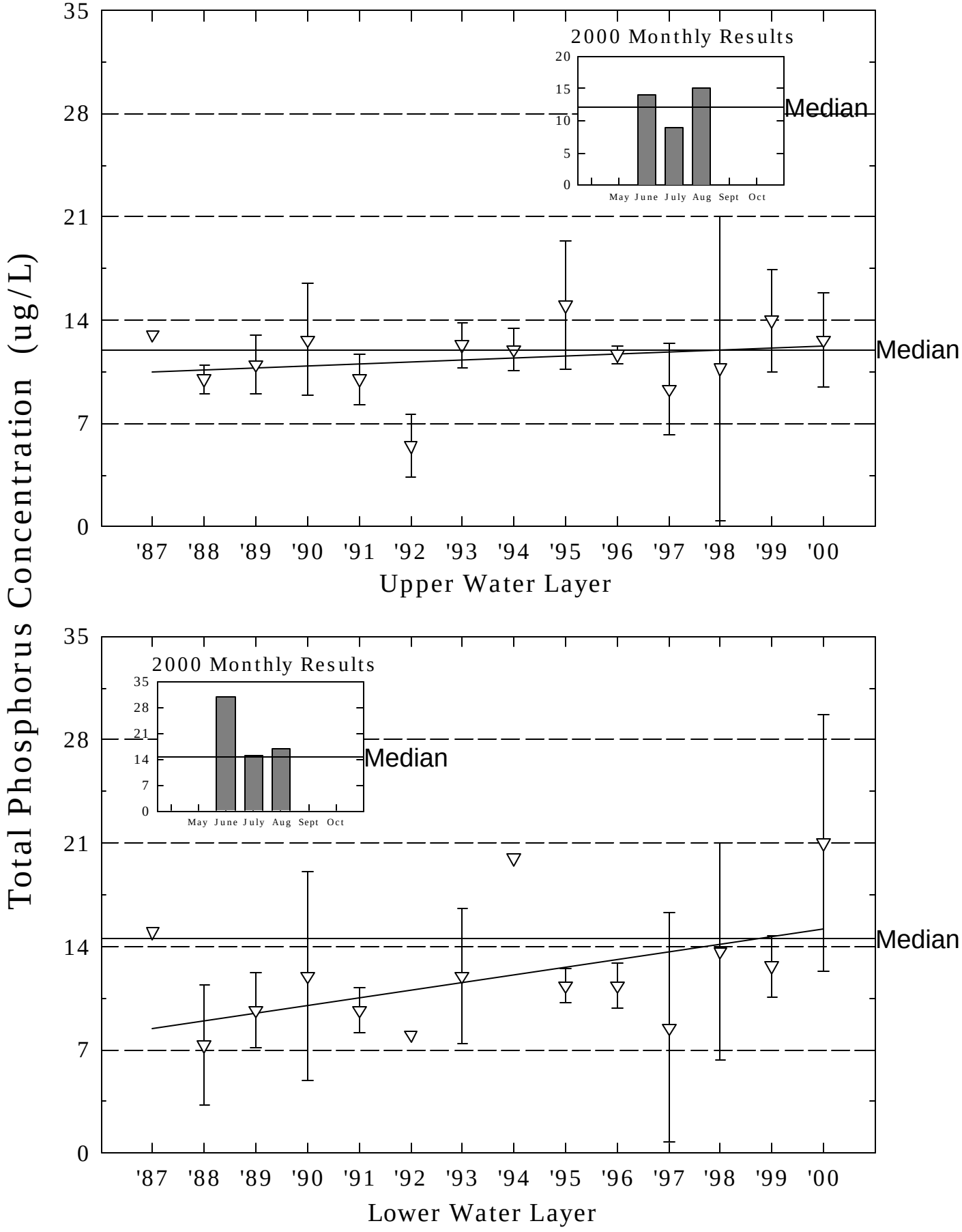


Table 1.

PERKINS POND

SUNAPEE

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1987	9.27	9.27	9.27
1988	3.56	9.22	6.08
1989	3.91	4.74	4.42
1990	3.84	7.35	5.59
1991	4.39	5.83	4.94
1992	2.75	3.67	3.21
1993	6.40	14.96	9.92
1994	8.53	9.65	9.02
1995	8.71	11.10	9.96
1996	3.46	7.89	6.14
1997	0.85	6.37	3.94
1998	6.09	7.61	6.85
1999	7.72	9.76	8.43
2000	9.53	10.83	10.34

Table 2.

PERKINS POND

SUNAPEE

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
09/23/1987	SYNEDRA	85
07/13/1988	DINOBRYON	49
	RHIZOSOLENIA	46
07/11/1990	DINOBRYON	29
	CHROCOCCUS	18
08/20/1991	DINOBRYON	40
	MICROCYSTIS	30
09/28/1992	MICROCYSTIS	49
	DINOBRYON	20
07/28/1993	PERIDINIUM	36
	DINOBRYON	18
	RHIZOSOLENIA	17
08/17/1994	MICROCYSTIS	89
08/22/1995	DINOBRYON	51
	MICROCYSTIS	17
	ARTHRODESMUS	8
08/19/1996	DINOBRYON	32
	GYMNODINIUM	24
	RHIZOSOLENIA	9
08/11/1997	MICROCYSTIS	24
	RHIZOSOLENIA	22
	TABELLARIA	12
09/14/1998	MICROCYSTIS	88
	SPHAEROCYSTIS	6
	ELAKATOTHRIX	4

Table 2.

PERKINS POND

SUNAPEE

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
07 / 19 / 1999	RHIZOSOLENIA	72
	DINOBRYON	13
	STAURASTRUM	4
08 / 10 / 2000	RHIZOSOLENIA	89
	TABELLARIA	4
	ARTHRODESMUS	3

Table 3.

PERKINS POND

SUNAPEE

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1987	2.3	2.3	2.3
1988	2.5	3.3	2.7
1989	2.5	2.8	2.6
1990	2.8	3.0	2.9
1991	2.2	3.0	2.6
1992	1.7	2.9	2.3
1993	2.1	2.4	2.2
1994	1.5	2.7	1.9
1995	1.6	2.3	1.9
1996	1.8	2.8	2.2
1997	2.0	2.7	2.2
1998	2.2	2.5	2.4
1999	2.0	2.3	2.1
2000	1.8	2.1	1.9

Table 4.

PERKINS POND

SUNAPEE

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1987	6.72	6.72	6.72
	1988	6.75	7.01	6.82
	1989	6.79	7.16	6.91
	1990	6.78	6.91	6.85
	1991	6.90	7.11	6.99
	1992	6.20	6.89	6.49
	1993	6.70	7.05	6.84
	1994	6.71	6.99	6.85
	1995	6.86	7.34	7.11
	1996	6.80	6.99	6.91
	1997	6.84	6.96	6.89
	1998	6.29	6.99	6.59
	1999	6.88	7.16	6.96
	2000	6.90	7.29	7.06
HYPOLIMNION				
	1987	6.81	6.81	6.81
	1988	6.33	6.74	6.58
	1989	6.72	7.07	6.86
	1990	6.89	6.95	6.92
	1991	6.90	7.11	6.96
	1992	6.38	6.60	6.48
	1993	6.80	6.98	6.89
	1994	6.78	6.78	6.78
	1995	6.53	7.49	6.92
	1996	6.64	7.01	6.79

Table 4.

PERKINS POND

SUNAPEE

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1997	6.79	6.84	6.81
	1998	5.81	7.03	6.30
	1999	5.71	6.80	6.11
	2000	6.91	7.30	7.01
INLET / OUTLET				
	1987	6.29	6.29	6.29
	1988	6.50	6.50	6.50
INLET				
	1993	6.05	6.05	6.05
	1996	6.40	6.40	6.40
	1998	6.02	6.86	6.37
	1999	6.77	6.83	6.80
	2000	6.19	6.50	6.34
LAUNCH BROOK				
	1989	6.38	6.38	6.38
LEDGE POND BROOK				
	1988	6.51	6.51	6.51
	1989	6.00	6.39	6.19
	1991	5.60	6.50	5.98
	1992	5.85	6.35	6.11
	1993	6.50	6.68	6.58
	1994	6.45	6.67	6.54
	1995	6.64	7.10	6.80
	1996	6.03	6.36	6.16
	1997	6.49	6.72	6.59

Table 4.

PERKINS POND

SUNAPEE

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1998	5.92	5.92	5.92
OUTLET				
	1990	6.72	6.72	6.72
	1992	6.86	6.86	6.86
	1993	6.55	6.91	6.66
	1994	6.45	6.90	6.66
	1995	6.74	7.22	6.99
	1996	6.48	6.72	6.55
	1997	6.62	6.68	6.65
	1998	6.40	6.76	6.60
	2000	6.33	6.39	6.36

Table 5.

PERKINS POND

SUNAPEE

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1987	5.20	5.20	5.20
1988	4.60	5.00	4.77
1989	4.30	5.00	4.67
1990	3.90	4.70	4.40
1991	3.80	7.90	5.70
1992	4.70	6.20	5.37
1993	4.80	5.80	5.30
1994	5.20	5.90	5.63
1995	5.70	7.00	6.53
1996	4.70	6.60	5.47
1997	4.40	4.50	4.47
1998	6.00	7.20	6.60
1999	4.50	11.10	6.97
2000	5.50	7.60	6.23

Table 6.

PERKINS POND

SUNAPEE

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1987	43.7	43.7	43.7
	1988	43.7	45.7	44.4
	1989	44.7	46.3	45.5
	1990	40.6	49.0	43.6
	1991	42.2	44.2	43.2
	1992	40.8	45.4	43.2
	1993	40.7	47.4	43.1
	1994	46.6	48.4	47.6
	1995	48.9	52.7	51.2
	1996	46.0	50.2	47.6
	1997	46.8	48.8	48.1
	1998	52.5	53.5	52.9
	1999	59.8	61.6	60.9
	2000	56.6	61.7	59.5
HYPOLIMNION				
	1987	43.8	43.8	43.8
	1988	42.6	45.1	43.7
	1989	45.5	46.1	45.8
	1990	40.9	42.0	41.4
	1991	42.9	43.6	43.3
	1992	40.5	45.1	42.8
	1993	40.7	46.0	42.5
	1994	46.2	46.2	46.2
	1995	49.5	52.4	51.3

Table 6.

PERKINS POND

SUNAPEE

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1996	45.6	49.4	47.6
	1997	48.8	48.8	48.8
	1998	52.1	53.3	52.6
	1999	59.7	61.6	60.8
	2000	56.7	64.6	60.7
INLET / OUTLET				
	1987	41.9	41.9	41.9
	1988	44.3	44.3	44.3
INLET				
	1993	41.0	41.0	41.0
	1996	29.4	29.4	29.4
	1998	33.7	35.5	34.3
	1999	36.2	44.4	40.3
	2000	28.4	46.7	35.8
LAUNCH BROOK				
	1989	39.3	39.3	39.3
LEDGE POND BROOK				
	1988	29.9	29.9	29.9
	1989	22.8	24.3	23.7
	1991	22.1	56.7	36.7
	1992	23.3	31.8	27.0
	1993	25.2	28.4	26.8
	1994	23.2	30.8	26.5
	1995	30.6	47.0	39.8
	1996	22.0	25.3	23.6

Table 6.

PERKINS POND

SUNAPEE

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1997	28.2	45.6	35.5
	1998	24.0	24.0	24.0
OUTLET				
	1990	45.0	45.0	45.0
	1992	62.1	62.1	62.1
	1993	40.9	46.7	43.0
	1994	46.0	48.4	47.1
	1995	49.3	52.8	51.5
	1996	45.8	53.0	48.8
	1997	47.8	49.3	48.7
	1998	53.3	60.3	55.9
	2000	32.3	40.6	36.4

Table 8.

PERKINS POND

SUNAPEE

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1987	13	13	13
	1988	9	11	10
	1989	9	13	11
	1990	10	17	12
	1991	9	12	10
	1992	4	7	5
	1993	11	14	12
	1994	11	13	12
	1995	12	20	15
	1996	11	12	11
	1997	6	12	9
	1998	4	26	10
	1999	12	18	14
	2000	9	15	12
HYPOLIMNION				
	1987	15	15	15
	1988	3	11	8
	1989	7	12	9
	1990	7	17	12
	1991	8	11	9
	1992	8	8	8
	1993	7	16	12
	1994	20	20	20
	1995	10	12	11
	1996	10	13	11

Table 8.

PERKINS POND

SUNAPEE

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1997	3	14	8
	1998	8	22	13
	1999	11	15	12
	2000	15	31	21
INLET / OUTLET				
	1987	12	12	12
	1988	1	1	1
INLET				
	1993	15	15	15
	1996	16	16	16
	1998	17	22	19
	1999	21	53	37
	2000	11	36	26
LAUNCH BROOK				
	1989	14	14	14
LEDGE POND BROOK				
	1988	26	26	26
	1989	18	26	21
	1991	12	25	18
	1992	9	16	12
	1993	12	17	14
	1994	11	24	17
	1995	14	20	16
	1996	13	15	14
	1997	10	19	14
	1998	17	17	17

Table 8.

PERKINS POND

SUNAPEE

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
OUTLET				
	1990	12	12	12
	1992	17	17	17
	1993	8	13	10
	1994	12	18	15
	1995	15	21	17
	1996	10	41	22
	1997	8	14	11
	1998	14	17	15
	2000	19	23	21

Table 9.

PERKINS POND

SUNAPEE

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
		August 10, 2000	
0.1	23.7	9.2	108.8
1.0	23.6	10.5	124.1
2.0	23.4	9.5	111.6
3.0	21.8	8.0	90.8

Table 10.

PERKINS POND

SUNAPEE

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
September 23, 1987	3.0	16.0	9.2	93.0
July 13, 1988	2.5	26.6	9.1	112.0
August 28, 1989	2.0	20.3	8.5	93.0
July 11, 1990	2.5	22.5	8.5	98.7
August 20, 1991	3.0	21.5	7.8	88.9
September 28, 1992	2.5	15.9	9.0	91.2
July 28, 1993	2.5	20.7	8.1	89.0
August 17, 1994	2.5	20.1	8.7	94.0
August 22, 1995	3.0	23.7	3.2	37.0
August 19, 1996	2.5	23.6	8.0	94.0
August 11, 1997	2.5	24.8	8.0	95.0
September 14, 1998	2.5	19.2	8.1	87.0
July 19, 1999	2.5	26.1	7.2	88.0
August 10, 2000	3.0	21.8	8.0	90.8

Table 11.

PERKINS POND

SUNAPEE

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1992	1.0	1.6	1.3
	1993	1.7	1.7	1.7
	1994	1.7	2.9	2.3
	1995	2.3	3.5	2.9
	1996	1.0	1.4	1.2
	1997	0.7	1.5	1.0
	1998	1.3	1.9	1.6
	1999	0.9	1.9	1.5
	2000	0.9	1.8	1.4
HYPOLIMNION				
	1992	1.1	2.0	1.5
	1993	1.5	1.6	1.5
	1995	2.0	4.0	3.0
	1996	0.9	1.2	1.0
	1997	0.4	1.7	1.0
	1998	1.4	2.4	1.8
	1999	1.1	1.8	1.5
	2000	0.9	5.5	2.8
INLET				
	1993	1.3	1.3	1.3
	1998	0.8	2.0	1.3
	1999	1.7	6.1	3.9
	2000	0.1	2.6	1.4
LEDGE POND BROOK				
	1992	0.6	1.4	1.0

Table 11.

PERKINS POND

SUNAPEE

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
	1993	0.6	0.6	0.6
	1994	0.7	1.2	0.9
	1995	0.6	1.3	0.9
	1996	0.3	0.7	0.5
	1997	0.6	0.7	0.6
	1998	1.3	1.3	1.3
OUTLET				
	1993	1.6	1.8	1.7
	1994	2.5	2.6	2.5
	1995	3.5	4.5	4.0
	1996	1.2	1.3	1.2
	1997	1.0	1.6	1.3
	1998	1.1	1.5	1.3
	2000	0.8	2.3	1.5

Table 12.

PERKINS POND

SUNAPEE

Summary of current year bacteria sampling.
Results in counts per 100ml.

Location	Date	E. Coli See Note Below
NO NAME		
	June 19	2
	July 10	2

NOTE: "<" means "less than" and ">" means "greater than"